Thermocline Variabilty in the Eastern Pacific Warm Pool

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ABSTRACT

While there is a direct relationship between the thermocline topography and the geostrophic current system (e.g. ridging associated with the North Equatorial Current and North Equatorial Counter Current), the relationship between thermocline topography and sea surface temperature (SST) is more subtle. The thermocline in the northeastern tropical Pacific has a zonally oriented trough-ridge-trough structure that terminates in a bowl and dome system offshore of Costa Rica. The trough-ridge-trough structure iscaused by the reduction in the trade winds in the Inter-tropical Convergence Zone (ITCZ). The dome/bowl system is formed by the wind stress curl patterns resulting from Central American Cordillera gap winds interacting with the ITCZ. The thermoc line bowl is in the heart of the North East Pacific Warm Pool, while SST above the Costa Rican dome is anomalously cool. In contrast, beneath the ITCZ the thermocline ridge brings cold water near to the surface; yet this region is considered the thermal equator and has some ofthe warmest surface waters on the globe. The EPIC enhanced TAO moorings along 95W lie in the path of the Tehuantepec wind jet, along the western edge of the Costa Rica Dome, and on the migratory path of the ITCZ. In this preliminary study, 95W mooring data are examined in conjunction with satellite wind, sea surface height, rain, and SST data to identify the structure and evolution of the thermocline topography, in relation to the ITCZ and gap winds.

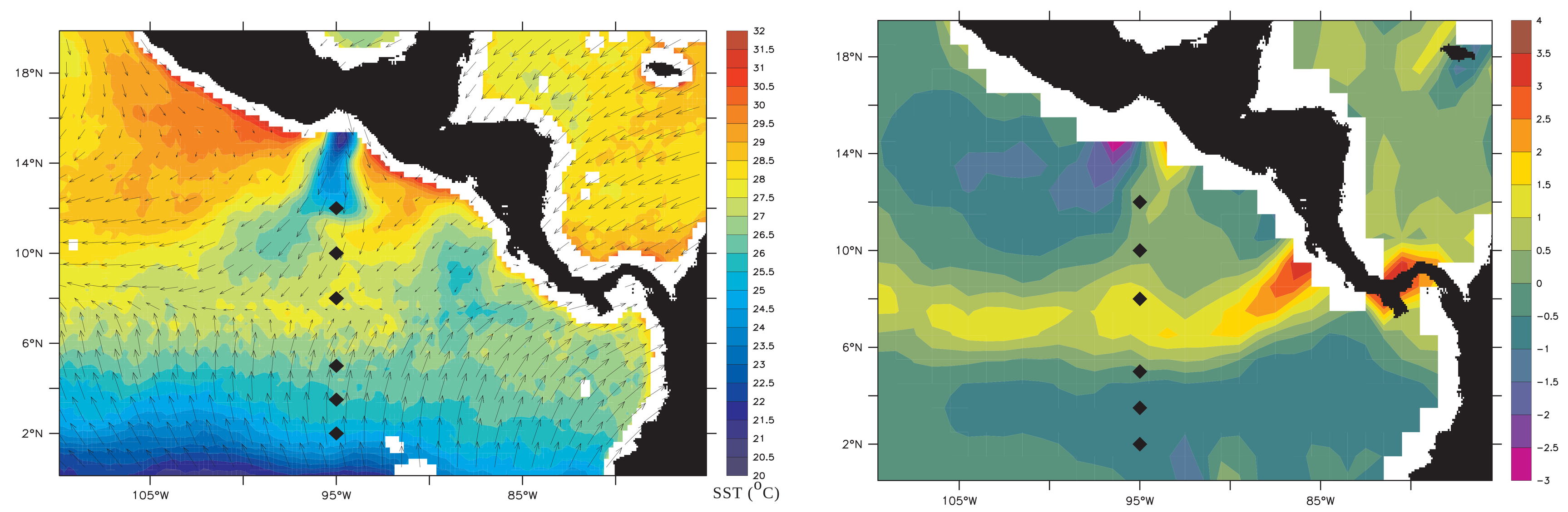

Figure 1. TAO/EPIC moorings, along 95W, shown in relation to November 2001 TMI SST and QuikSCAT wind fields (left) and in relation to Wind Stress Curl (right).

The 95W moorings lie directly in the Path of the Tehuantepec wind jet. The moorings are also influenced by the positive wind stress curl reaching west from the Gulf of Papagayo.

The effect of the wind forcing can be seen on the sea surface height (SSH) fields, which are directly related to the ocean currents.

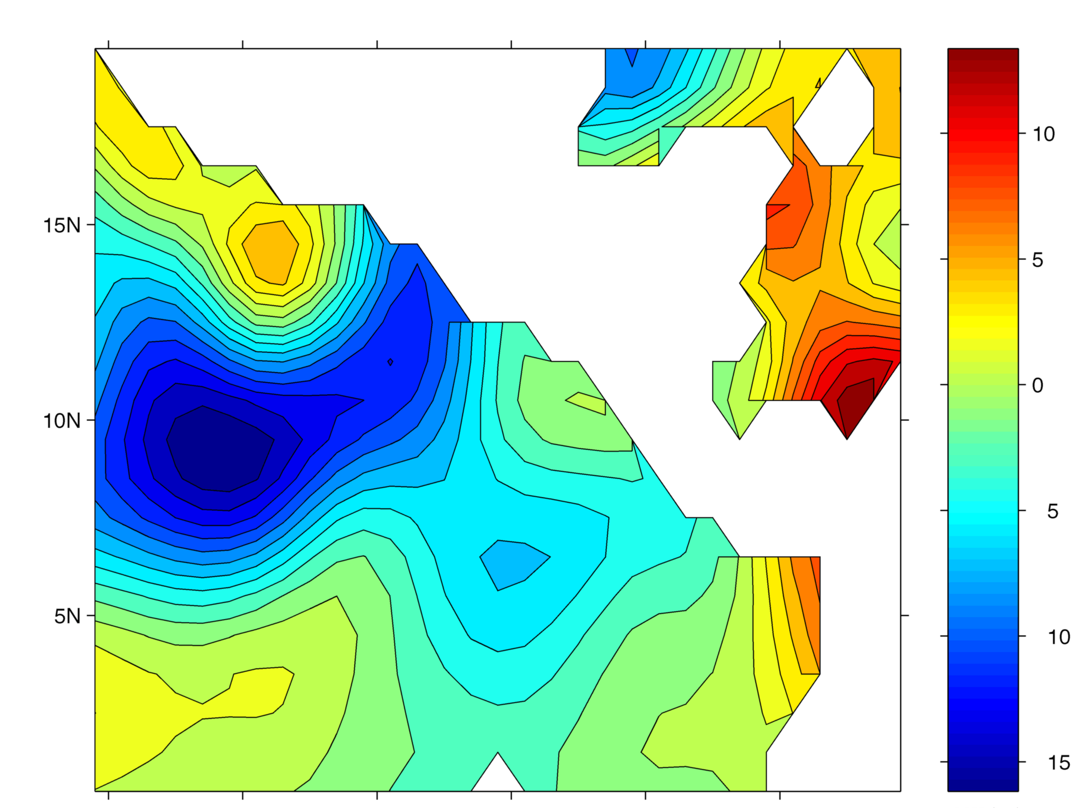

Figure 2. November 2001 TOPEX/POSIEDON SSH

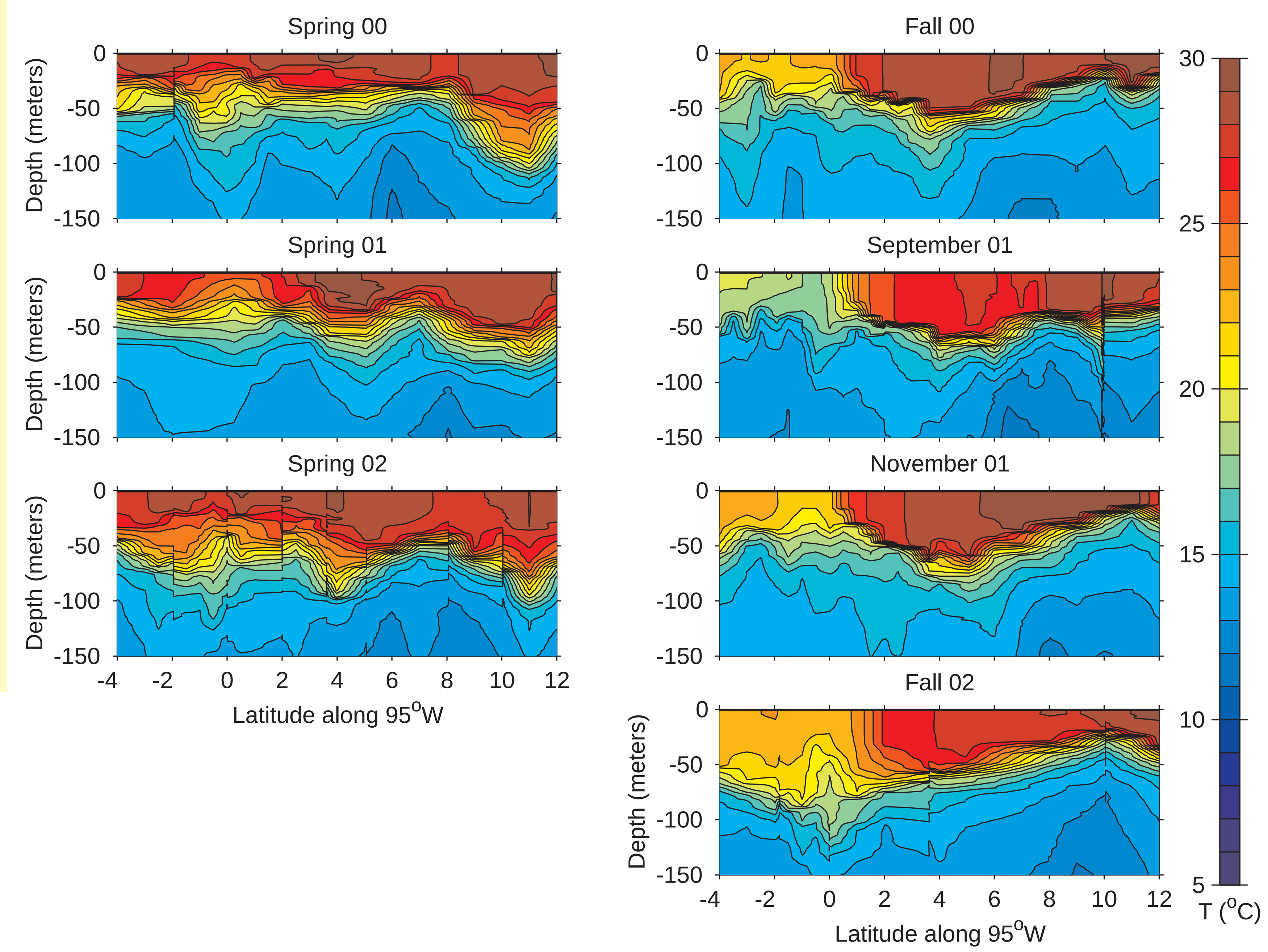

Figure 3. Temperature profiles produced from CTD sections done from TAO mooring maintenance cruises and the EPIC 2001 cruise (September 01).

The fall sections have a relatively consistent temperature structure north of the equator. The thermocline at 10N is relatively shallow. Despite variablity in the spring ITCZ, the temperature structure in the north is fairly consistent. The thermocline at is deep at 10N.

The oscillating pattern seen in the north corresponds to ITCZ position. The thermocline tends to be shallowest when the ITCZ is in its nothernmost position. Similary, the thermocline is generally deepest when the ITCZ is in its southernmost position.

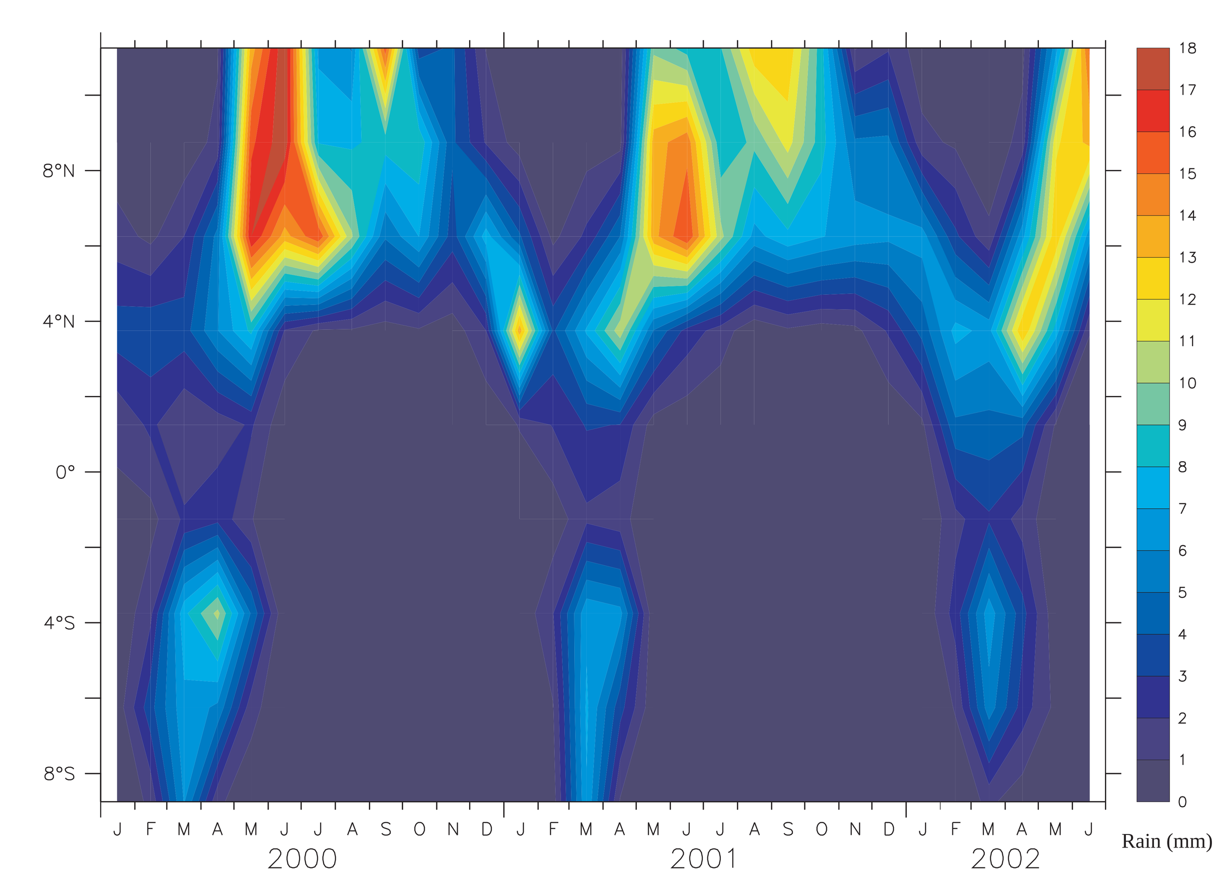

Figure 4. The annual march of the ITCZ seen from a timeseries of Xie and Arkin integrated monthly rainfall, along 95W.

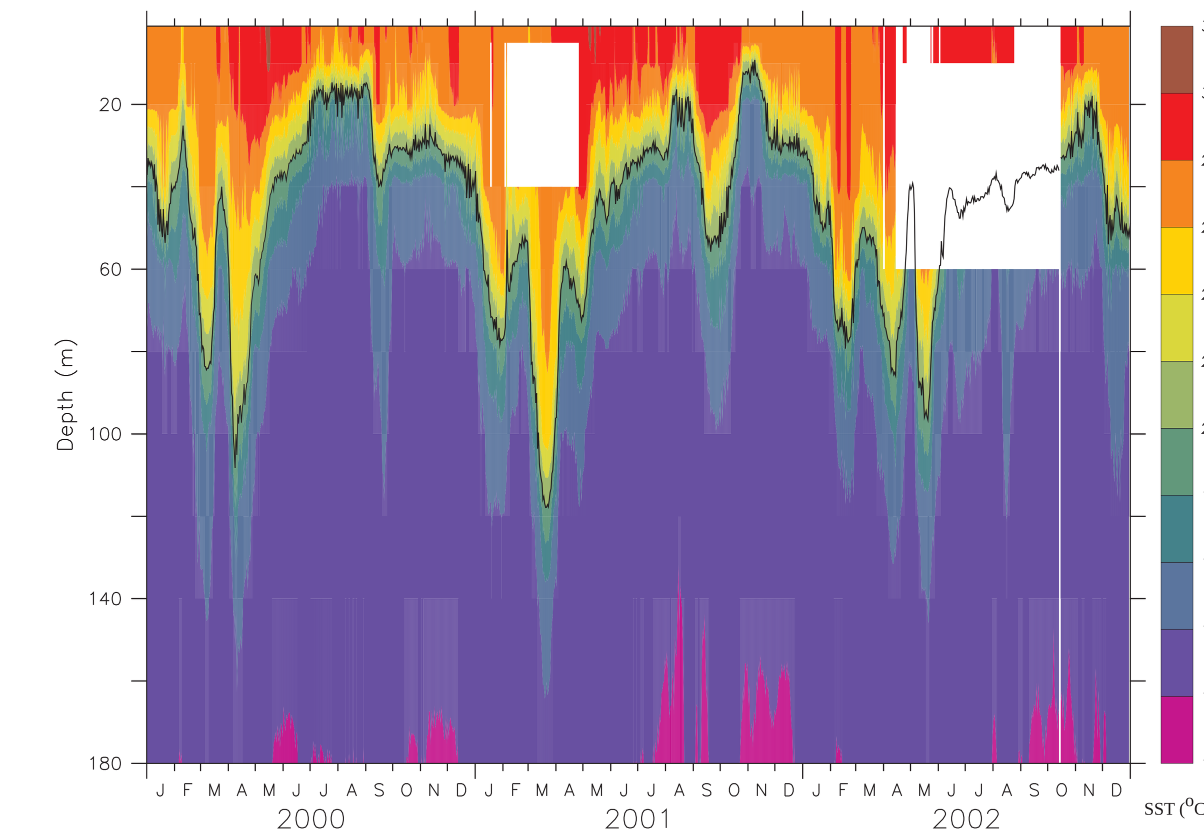

Figure 5. A timeseries of temperature taken from the TAO/EPIC mooring at 10N, 95W. The 20^{o}C isotherm is shown in black

The annual cycle in thermocline depth at 10N (fig 5) corresponds to Rossby waves forced by wind stress curl, shown in figure 6.

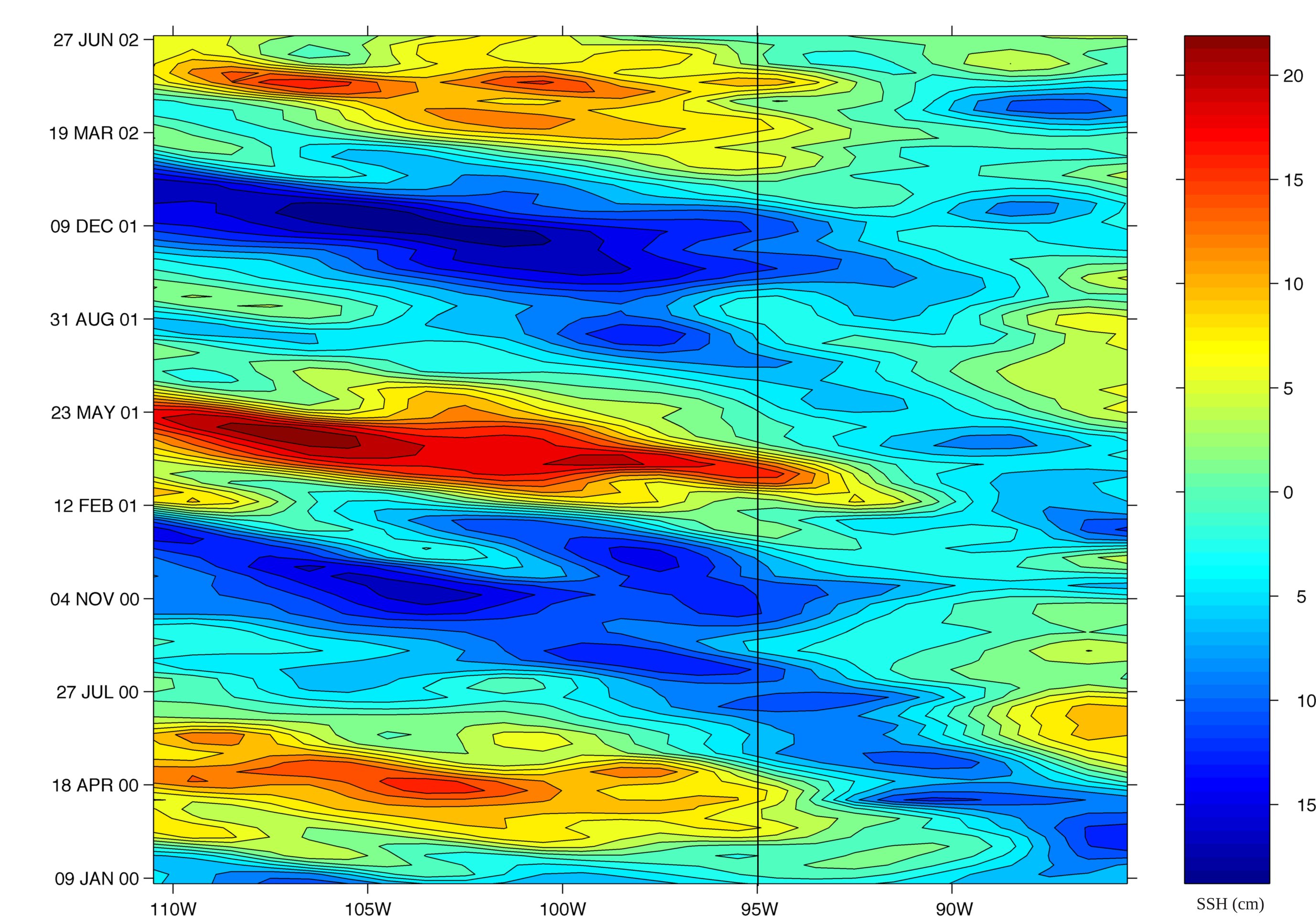

Figure 6. Rossby waves in a timeseries of TOPEX/POSIEDON SSH at 9.5N.

Further investigation will include the use of satellite data to identify the Costa Rica Dome and identify its fomation and movement in the thermocline variability. Ultimately this study will also involve alaysis of the ITCZ freshwater input, regional heat budget, surface buoyancy fluxes and their influence on the coupled ocean-atmosphere circulation patterns.